

INTERPRETING A SPECIES LIST: AN ANALYSIS OF THE MACRO-MOTHS RECORDED AT A BANFFSHIRE SITE, 1990-2002

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Abstract

Macro-moths were surveyed at a site in north-east Scotland from 1990 to 2002; 274 species were found. Only 66% of these species are considered resident on the site throughout the period of the survey, the remainder being temporary residents (14%), strays (15%), or migrants and adventives (5%). Other sites may show a similar pattern.

Introduction

After moving to Banffshire, I began recording macro-moths at my new home site in 1990. Previously I had done the same in Lancashire and then Sussex, but here was the opportunity for a fresh start. Although Barbour (1974) had produced the first list of the vice-county's macrolepidoptera, this mainly covered the western parts, and the eastern side of Banffshire was almost unknown. Virtually every species would be a new record for my 10km square, if not for me.

However, there is recording and there is recording. I wanted something more than just a site list. Or rather, I wanted a site list that I could interpret, quantify and qualify, with hard data to back up (or confound) my assumptions and hunches. That meant the recording needed to be reasonably systematic and consistent, without going to tedious extremes. After all, this was recreation, not work.

Site and methods

Whitewells is a croft with 14.5 hectares (35 acres) of land. The garden and steading cover about one acre, permanent pasture comprises 12 acres, but the rest is excellent semi-natural habitat, part of a very varied, unimproved wet hillside dominated by rushes and sedges that rises to drier heather moorland with belts of gorse. For my recording area, I decided to use the whole of one-kilometre O.S. grid square NJ 5755, in which the croft is roughly central. The characteristic deciduous trees are willows (*Salix caprea*, *S. cinerea* and *S. aurita*), alder *Alnus glutinosa*, birch *Betula* spp. and rowan *Sorbus aucuparia*, while there are scattered clumps of larch *Larix decidua* and Scots pine *Pinus sylvestris* on drier parts of the hillside itself. However, this is relatively open country, with little actual woodland as such. In altitude, the recording site ranges from 140 metres (430 feet) to 260 metres (800 feet) above sea level, on a north-facing slope that then drops more gently towards the coast 11 kilometres away. The wider area of the 10km square is given over to mixed arable and pastoral farmland, again very open except for a few small spruce plantations. Fields are bounded by drystone dykes, ditches and barbed wire rather than hedges.

Moths were recorded by a wide variety of methods. A Robinson light trap with a 125 watt bulb was run on suitable nights from spring to late autumn, always in the

garden. The catch, however disappointing or mundane, was faithfully recorded by numbers of individuals as well as species. At this latitude the weather is often wholly unsuitable, or at least marginal, so if no more moths were arriving the trap would often be taken in at midnight. Nor is there any proper darkness either side of the summer solstice, again affecting catches. However, the trapping regime was roughly consistent throughout the study period. Lighted windows backed up the Robinson trap; surprisingly, they often attracted a different mix of species.

Secondly, "sugar" was used on virtually every possible night, even in December and January if mild enough. The same 25 fenceposts (just across the road from the house) were used throughout, nor was the sugar recipe altered. Again, consistency was the aim. At night, natural attractions including sallow catkins, heather and ripe blackberries were regularly worked in their seasons, likewise garden flowers such as honeysuckle and buddleia. Moths were also found by torchlight sitting around on bushes and other vegetation.

Daytime fieldwork was regularly employed, both for diurnal moths and others such as geometrids that can easily be disturbed by day or found at rest. In general, less effort went into searching for the early stages, though the caterpillars of numerous species were found casually or sometimes deliberately.

The basic site list

I do not propose to list in this paper every moth ever recorded from my site – that would bore most readers – but would be happy to send the full list to anyone requesting it. Instead, my aim is to analyse and interpret the records. Although in detail this analysis can apply only to my particular site, the underlying principles will be relevant to most sites and most types of moth recording.

Over the thirteen-year period from 1990 – 2002, no less than 274 species of macro-moth (defined as the families covered by Skinner, 1998) were recorded from the one-kilometre square NJ 5755. This is a surprising total, perhaps, from such a northerly location. Of these, 33 species were first records for VC 94 when found. However, the average annual total was only 197 species, ranging from 181 in 1993 to 220 in 1996 (Fig. 1). In fact, only 135 (under half) of the species were seen in all thirteen years. Surprisingly, the second-highest category comprised moths seen, usually as singletons, in one year only (Fig. 2).

The list also emphasises the value of using different methods of finding moths rather than relying solely on the mercury vapour light trap. Of the 274 species, 23 (8%) were never recorded at the light trap. Of these, 12 were found only by daytime fieldwork. Naturally these included purely diurnal species like Six-spot Burnet *Zygaena filipendulae*, Common Heath *Ematurga atomaria* and Wood Tiger *Parasemia plantaginis*, plus others that seem to be largely diurnal here, such as Satyr Pug *Eupithecia satyrata callunaria* and Double-striped Pug *Gymnoscelis rufifasciata*. Sugar, though very productive, only added four species that otherwise would not have been seen: Turnip Moth *Agrotis segetum*, Old Lady *Mormo maura*, Crescent *Celaenaleucostigma* and Small Fan-foot *Herminia grisealis*. However, sugar proved invaluable for assessing the numbers and status of moths that come less frequently to

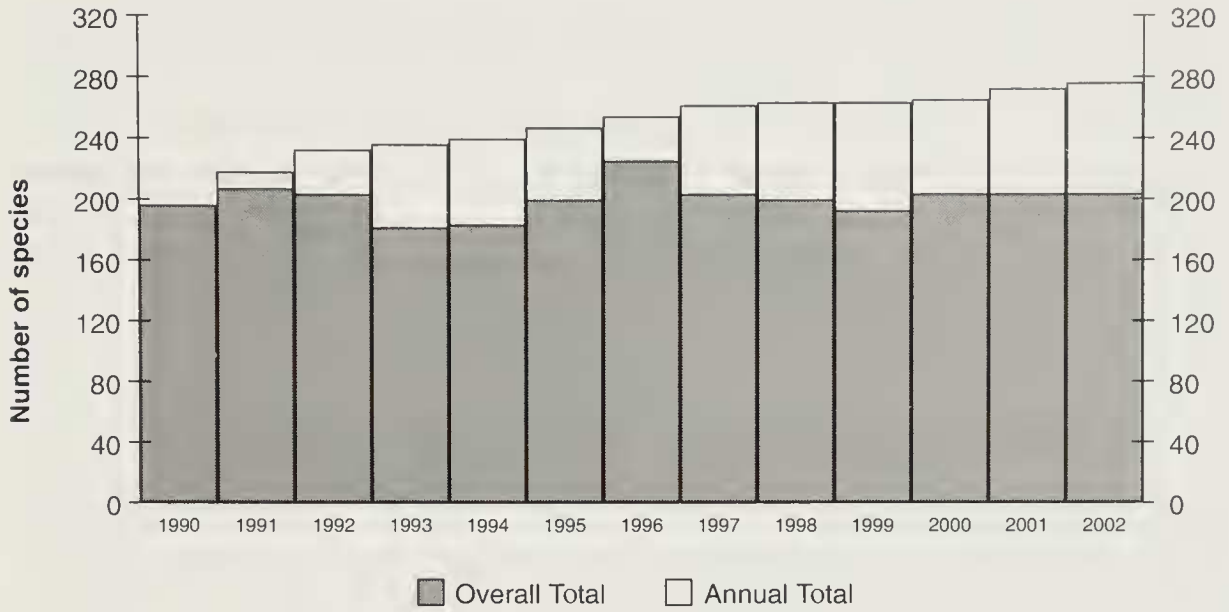


Figure 1. Annual totals and overall totals of macro-moths recorded at Ordiquhill, Banffshire during 1990-2002.

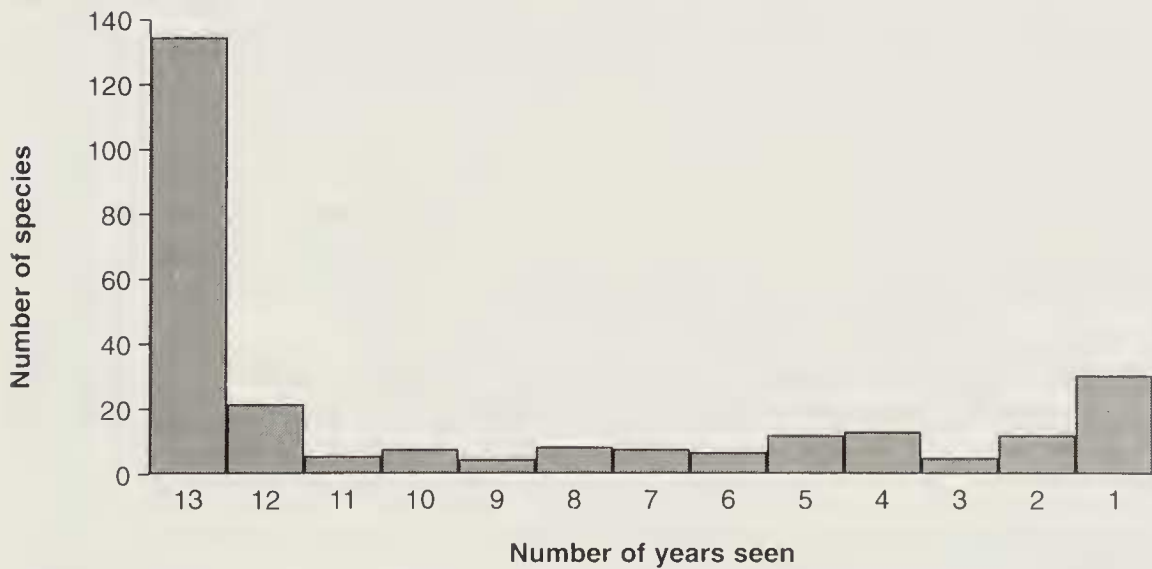


Figure 2. Species of macro-moths recorded at Ordiquhill, Banffshire during the thirteen years 1990-2002 against the number of years in which they were seen.

light. A further five species were recorded only at flowers, but these included some memorable finds: Vestal *Rhodometra sacraria*, Bedstraw Hawk-moth *Hyles gallii* and Bordered Straw *Heliothis peltigera*.

On the other hand, 41 (15%) of the 274 species were recorded only at the Robinson trap. Most of these were migrants or strays, but they included at least four species believed to be low-density residents on the site: Brussels Lace *Cleorodes lichenaria*, Heath Rustic *Xestia agathina*, Nut-tree Tussock *Colocasia coryli* and Plain Golden Y *Autographia jota*. A further ten or so of the 41 species were probably temporary residents during part of the recording period. It is too simple to say that all these species would have been missed without the use of mercury vapour light. Such an effective means of attracting moths engenders laziness; without it I would have been forced to do more traditional fieldwork, and may well have found at least some of the missing residents.

It is a measure of the difference between macrolepidoptera and microlepidoptera recording that not one of the species was found only in its early stages (apart from an adventive). However, a few were most frequently seen as caterpillars, particularly Ruby Tiger *Phragmatobia fuliginosa borealis*. Its larvae were often numerous from February onwards in spring, with cocoons in the heather later, but most years I never saw the adult moth either in the daytime or at light.

Defining and assessing status

Like any site list, mine consisted of resident species augmented by obvious migrants and probable strays. Would it be possible to allocate every species to its appropriate category, using the amassed data purely objectively? Unsurprisingly, the answer was no. For instance, that indisputable migrant the Silver Y *Autographia gamma* was far more abundant and regular than its resident congeners Plain Golden Y and Gold Spangle *A. bractea*. Overall, the Dark Sword-grass *Agrotis ipsilon* far outnumbered the Gothic *Naenia typica*, a low-density resident not seen at all in some years. Frequency alone could not distinguish between my single Clifden Nonpareil *Catocala fraxini* from across the North Sea and the single Old Lady presumably from the valley of the River Deveron only 15km away. Clearly, a subjective element was also required. All factors had to be considered; often the best that could be achieved was an educated guess based on the most likely (or least unlikely) scenario. Doubtless further work will prove that some of my assessments were wrong. Even so, I feel that the exercise was worth doing. The species seemed to fall into six categories, as follows:

Permanent residents (181 species, 66%)

Definition: species breeding continuously on the site throughout the survey period.

This verdict was based on a combination of numbers recorded plus annual regularity. Of course, some species are very abundant, like the Large Yellow Underwing *Noctua pronuba*, while others such as the Herald *Scoliopteryx libatrix* persist at much lower densities. Species were not disqualified from this category just because only one or

two specimens were seen annually or with only the occasional missed year. Even relatively numerous residents like Brown-spot Pinion *Agrochola litura*, Mouse Moth *Amphipyra tragopoginis* and Marbled Minor *Oligia strigilis* had the odd poor year when none was seen. Many, but not all, of the species in this category were also found in their larval stage, giving added confirmation.

Temporary residents (39 species, 14%)

Definition: species considered to have bred on the site for only part of the survey period.

This category was more debatable. Species placed in it tended to show a pattern of occurrence in several consecutive years, interspersed with a gap or gaps of three or more years of apparent absence. However, species recorded even less frequently were automatically placed in this category if larvae were found (with the exception of Silver Y). Thus only two adults of the Brindled Pug *Eupithecia abbreviata* were trapped during the survey, in 1997 and 2001, and were thought to be strays until its caterpillar was found on one of the few oaks in 2002. Broken-barred Carpet *Electrophaes corylata* would also have been considered a stray, with only four singles to light over 13 years, if a pupa had not been dug from beneath a hillside rowan in 1999.

Other examples were Cabbage Moth *Mamestra brassicae* and Heart and Dart *Agrotis exclamationis*, caught annually in small numbers during the early years of the study but not seen lately, whereas Common Wainscot *Mythimna pallens* and Clouded Border *Lomaspilis marginata* were initially absent but now breed. The latter has recently colonised north-east Scotland as a whole (Palmer & Young, 1994). Then there were a few species that seemed to come and go, as if the site were not quite large enough or good enough to maintain a permanent population. They included Northern Deep-brown Dart *Aporophyla lueneburgensis* and Light Knot Grass *Acronicta menyanthidis*.

Local strays (29 species, 11%)

Definition: species originating from elsewhere within the same 10km square or an adjacent one.

Infrequency was one criterion: species were considered to be strays if they were recorded so rarely and at such long intervals that they were unlikely to be even temporary residents. A second and perhaps more compelling qualification was absence of the foodplant or of the required habitat, but these were both known to be present elsewhere within the same or an adjoining 10km square. Often the moth concerned was known to occur there too. Many such strays were recorded on one occasion only. Some were apparently from the coast, 11km away to the north, others most likely came from mature woodland or less acid soils. Those lacking foodplant at the site included Rivulet *Perizoma affinitata* (no red campion), Brown Silver-line *Petrophora chlorosata* (no bracken), Marbled Coronet *Hadena confusa* (no sea or bladder campion) and Orange Sallow *Xanthia citrago* (no lime).

Regional strays (11 species, 4%)

Definition: species originating from beyond an adjacent 10km square, but within north-east Scotland.

Here, foodplant and habitat again provided the clues. If there was no habitat or foodplant within the same or an adjoining square, the moth was presumed to have come from further afield. This applied to the occasional specimens of Chestnut-coloured Carpet *Thera cognata*, Juniper Pug *Eupithecica pusillata* and one Manchester Treble-bar *Carsia sororiata*, the nearest suitable habitat being 30km or more away. Also placed in this category was the single Cinnabar *Tyria jacobaeae*, its nearest known colony being 90km away in Kincardineshire.

Migrants (13 species, 5%)

Definition: species known to migrate, originating outside NE Scotland and probably from overseas.

The site did surprisingly well for migrants considering its latitude, nor is it even on the coast. Well-known migrants recorded, besides those already mentioned, included Convolvulus Hawk-moth *Agrius convolvuli*, Hummingbird Hawk-moth *Macroglossum stellatarum*, Pearly Underwing *Peridroma saucia* and Great Brocade *Eurois occulta* of the pale grey immigrant form. Also considered to be migrants, since they are not known to be resident in north-east Scotland, were the single Turnip Moth (in September) and two Crescent, the latter apparently of the nominate subspecies rather than the Highland race *scotica*. A further two species resident on the site also occurred as migrants, but are not counted as such in this analysis. Setaceous Hebrew Character *Xestia c-nigrum* is univoltine here, flying in July, but one was recorded in May and several in autumn associated with influxes of known migrants like Dark Sword-grass. Similarly, unusual numbers of Angle Shades *Phlogophora meticulosa* often appeared during these influxes. None of the migrant *Mythimna* species was seen; curiously they have never been reported from north-east Scotland.

Adventive (1 species)

Definition: a species accidentally transported to the site in goods or produce.

A small caterpillar of the Scarce Bordered Straw *Helicoverpa armigera* was found in a packet of mange-tout peas from Zambia, and the moth reared.

Discussion

During the 13-year survey period, 80% of the species found were believed to have been resident on the site in some years at least. All the permanent residents had been found by the end of the fourth year (the last of these being Lunar Hornet *Sesia bembeciformis*, a species not attracted to light, sugar or flowers). The remaining 20% were considered to be casuals: purely strays, migrants or adventives (Fig. 3). However, if their foodplant is present and the climate becomes suitable, such species

are potential colonists. In spite of the length and intensity of recording, a few new casuals are still being added nearly every year. Most of the further 48 species on the Banffshire list, plus others in neighbouring vice-counties, are within straying distance and may turn up sooner or later.

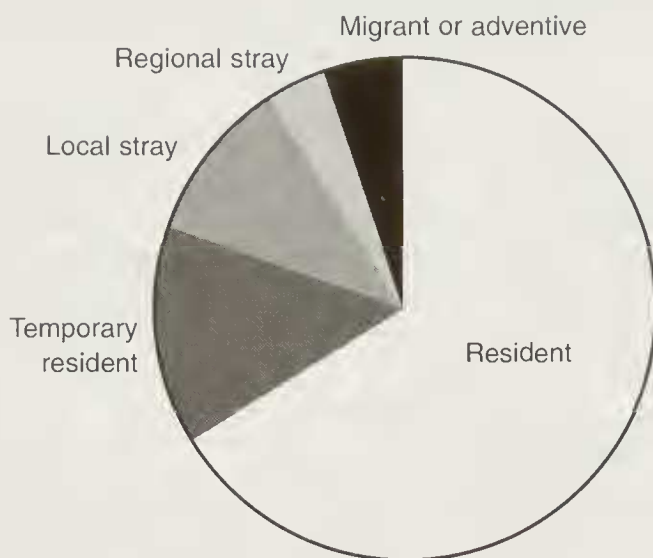


Figure 3. A breakdown, by most likely status, of 274 species list of macro-moths recorded at Ordiquhill, Banffshire during 1990-2002.

So how typical is my site? Will other well-worked sites show a similar pattern? Almost certainly, the answer is a qualified yes. Moths are relatively mobile insects: they do move around. However, a stray from further afield will only be recognised as such if it does not normally occur in that area. We notice the Redwings *Turdus iliacus* and Fieldfares *T. pilarus* that visit us in winter from Scandinavia, but not the Blackbirds *T. merula* that come with them. Therefore, the percentage of strays in any site list will depend on the local circumstances. A list from an area of varied, prime habitat surrounded by much less interesting countryside will have very few such species, since most of the moths arriving as strays will already breed there. By contrast, an impoverished site surrounded by far better and more diverse habitat will have a much higher percentage of species that only occur as short distance strays or migrants. An extreme example would be an offshore oil rig, with no resident species. Finally, the length of the recording period will have an effect: with every passing year the proportion of 'casuals' on a site list will gradually increase (Fig. 4).

Conclusion

A simple species list can be misleading, however accurately it has been compiled. It sets the 'once in a lifetime' strays on the same level as the abundant residents. This is hardly a new observation, of course. I have tried to show that it is possible to make sense of a site list, to break it down into different categories, by methodically

recording numbers and frequency of the species seen. The use of many different fieldwork techniques to supplement light trap records leads to a far more accurate picture of status: many of my species were scarce or absent in the trap but easily found by other methods. Finally, analysing thirteen years of field notebooks from scratch would be a formidable task. Fortunately I summarised the data at the end of every year to produce an annual list, so merely needed to combine these accounts.

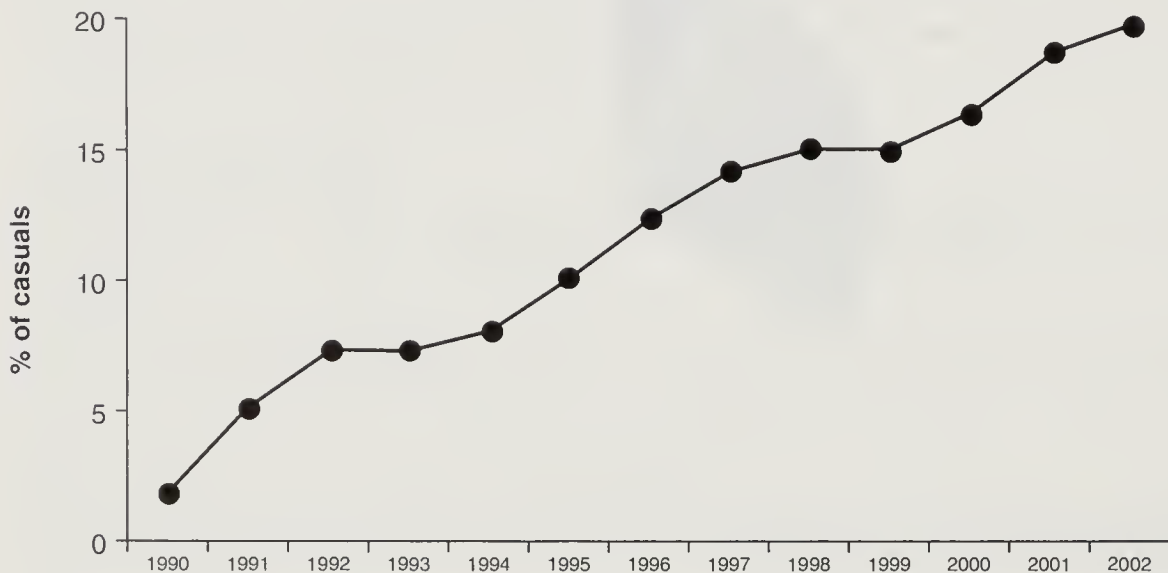


Figure 4. The rising percentages of casuals (strays, migrants and adventives) in a species list of macro-moths recorded at Ordiquhill, Banffshire during 1990-2002.

Acknowledgements

I thank my neighbours, Ron and Sheila Runcie and Jimmy and Phemie Addison, for allowing me to wander at will over their land at all hours of day and night. My son David expertly prepared the graph and histograms for me.

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